TECH TALKS | EPISODE 1 | THE FUTURE OF SPACE TECH

With Brett Loubert, Principal, US Space Leader, Deloitte Consulting LLP and Major General (Retired), Kim Crider, Managing Director, US National Security AI Practice Leader, GPS, Deloitte Consulting LLP

Raquel Buscaino: It's been over fifty years since two American astronauts made their first steps over the surface of the moon. Half a century later. This moment still remains, perhaps one of the most significant events in human history. Yet recent breakthroughs in space exploration may bring back this idea that there is no such thing as dreaming too big. On today's episode. We'll talk about a wide range of topics, from commercial space stations and the on demand space economy to reusability, and how AI is being used in space.

Welcome to Deloitte TECHTalks. I'm your host, Raquel Buscaino, and today we'll discuss the present and futures of the commercialization of Low Earth Orbit with two space leaders: Brett Loubert, who leads Deloitte's US Space practice, and Major General retired Kim Crider, who leads Deloitte National Security AI practice, and is the former chief technology and innovation officer of the US Space Force. Let's dive in.

Kim, Brett, welcome and thanks for joining us today.

Brett Loubert: Thanks for having us.

Raquel Buscaino: Let's start with something that's a little bit light-hearted. What is your favorite fun space fact? Brett, I'll go to you first.

Brett Loubert: Well, I'm currently located in Manhattan Beach, California, which is outside of Los Angeles, and I'm actually right now, 50% closer to the International Space Station than I am to San Francisco. We always think that space is so far away, but in reality it isn't. It's just a lot harder to get there.

Raquel Buscaino: Kim, what about yourself?

Kim Crider: One of the things that I think is such a fun fact about space that many people don't really realize is: today, there are roughly fifty-five hundred satellites in space, but by the end of the decade, so really just in a few more years, the estimate is that there will be fifty-eight thousand satellites in space. That estimate comes from our government accountability office[1], so we are pretty confident in that. That is a huge growth in space and that fact points to what we're seeing as being so exciting about this growing and booming space economy.

Raquel Buscaino: Wow! That really puts it in perspective. There is so much activity happening right now! Many of us have seen some of the incredible images that the James Webb telescope is bringing back from the earliest days of the known universe, or even heard about NASA's Dart Mission or double asteroid redirection test, which redirects the orbit of a non-threatening asteroid, and all these are examples of government activity, but there is quite a bit happening in the commercial sector as well. What are the most exciting advancements and space-related trends that you're seeing materialize in this commercial sector?

Brett Loubert: What probably excites me the most is the convergence of both government and commercial interest in space through what we're talking about as the commercialization of Low Earth Orbit (or LEO).For most of history, space was largely a government-owned and government-operated destination, and what we've seen over the past decade is this shift towards commercial outsourcing to include human space flight. In two thousand and twenty, NASA launched astronauts, the ISS, from a commercial spaceship. And why was this important? This is the first time in nine years that NASA had launched an astronaut from US soil.

Government still has a very critical and continued role in space but we're seeing more and more of these commercial use cases that close without the reliance of government funding. So these range from mega constellations, providing communications capability, to new and uses around In-space Servicing Assembly and Manufacturing, which is called ISAM, and it's encouraging that we'll ultimately benefit from all parts of this space system.

Kim Crider: Let me add to what Brett just laid out there, because he's absolutely right, the commercialization of space, the growth that we're seeing in all of these satellite launches is really driven by the fact that the commercial marketplace sees spaces as a place where they can generate revenue.

There are viable business models for leveraging space, providing information from space, and actually, beginning to think about providing capabilities in space for space.

A lot of what we do in space right now is pointed towards making things better on earth through satellite communications, through GPS, providing ISR, or other imaging capabilities for a variety of different uses, but we also see a growth in "space for space" , so space-based capabilities, Brett mentioned the growth in human space flight, and we're seeing that more companies are talking about what this could really look like: bringing the cost down, and creating viable platforms so that everyday professionals can go into space and do work. Do research. There is a lot of conversation about that happening in a relatively short amount of time.

The other thing that I think is really driving the space industry is the technology and how technology is becoming more available to help bring the cost down for launch, to bring the cost down for satellite development, and to bring the cost down for analyzing data in space, from space, in ways that we can now learn more and understand better what that space environment is about.

I'm talking about nano-technologies that have enabled us to build CubeSats (very small components onto satellites), technologies that have enabled for rocket reuse, so the ability to launch rockets into space and bring those launch vehicles right back down, artificial intelligence and machine learning technologies that are allowing us to leverage data more effectively from space, and again, in space as well where they're analyzing data right on the space platforms, and deriving insights at that source of sensing.

So, it's really an interesting time to think about all of the things that we can do in space today, and all the things that we will be able to do as we continue to get more capability up there.

Raquel Buscaino: Thinking about the future, one of the things that I wanted to bring up was a report[2] that Deloitte released on the commercialization of Low Earth Orbit. It says "The Vision for 2035 for a vibrant LEO economy, includes multiple on-orbit destinations, regular human rated access to space, the industrialization of on-orbit manufacturing, and robust on-orbit services." 2035 is not that far away! So, Brett, I'd love to hear from you. What do you think are some of the driving forces today that's going to make that vision actually realistic?

Brett Loubert: I think the absolute critical path to date has been launch. We're seeing a shift though, and I think this is the most important thing, everybody loves to talk about launch, the cost of launch, and the cadence of launch, but it used to be very supply-driven. So the government would say: "We have a manifest to launch this many satellites, please provide me a launch capability to get them into orbit".

We're seeing a market now that is much more demand-driven, and it's being driven by private and commercial investment opportunities as well. And with that, there's a domino effect, with the growing demand for more agile satellite operations and remote sensing, both Defense and Commercial, that create a foundational demand for launch providers and small satellite tech firms, which, in turns, fuels these economies, the scales, the cadence of launch that goes up, and driving down the price per launch.

Kim mentioned this in the last question. I really can't emphasize the reusability and sustainability side of what we're seeing in launches these days. When I was a kid, I remember getting in the cafeteria at school, and sitting around a TV to watch the shuttle launch. It was a really big deal. It didn't happen that often. Now, we have companies that are launching more than fifty times a year, which is absolutely mind blowing. Even as a space person, I usually find out about launches after the fact based on followers I have on social media. So launch is almost an afterthought at this point.

Reusability is a gigantic game changer when it comes to rockets and launch components. Think of the analogy: I take a flight from LAX to DC. I would never think about discarding the plane afterwards. As a matter of fact, I want to know that this plane has been in service for a long time, and has made a bunch of flights, that's reusability around launch: it is not just about reducing costs, but also around building confidence.

Another one is government support for early stage R&D. NASA recently announced it would fund early-stage R&D for three proposed commercial LEO destinations, which allows for use cases that we're thinking about today, and ones that we haven't imagined.

We talk a lot about sustainability on Earth but space debris is a problem, although a small problem right now, it could be a tremendously huge problem in the future, that's why there's new regulation in terms of when you're launching your large constellation, what's your de-orbit plan to make sure that space is sort of a pack-in/pack out scenario, where things are managed in a sustainable way. We're also seeing the rise of on-orbit servicing.

This will help clean up debris that we've already have that's out there, and make sure that we have a sustainable space.

Raquel Buscaino: You threw out this term, ISAM, which is in orbit servicing assembly and manufacturing, if I got that right. What does this actually mean? And how does this actually connect to space debris when we think about reusability and sustainability?

Brett Loubert: Well, when we started putting satellites and people on orbit, there was pretty much a "You can't fix it". You launch a satellite in orbit, and it works great, and it doesn't, you just spent a lot of money and your platform doesn't work in space.

So now we're thinking about ISAM and we say: "Well, What if I can do repair on orbit? What if I can refuel on orbit?" A lot of the satellites that we put in orbit exist in orbit and with a lifespan that's largely driven by the amount of propellant they have. The ability to refuel a platform throughout its life provides an intense amount of manoeuvrability. It provides resiliency to an architecture. It provides extended life to those platforms, and I think that's going to be one huge game changer, especially for national security-type missions in space.

On the commercial side, we're seeing this increased cadence of launch that largely goes to LEO. Now, if there's capabilities that can drag things from a LEO orbit to a higher orbit, then we're going to see a tremendous amount of capability that is provided on-demand, and at a reduced cost, because the cost of launching something to one of those orbits is extremely high, versus moving them in sort of more of a "hub and spoke" model.

Raquel Buscaino: That's fascinating. It's like the gas stations, the roads along the way.

Brett Loubert: I like that gas station analogy. If you were to take a trip from Los Angeles to Phoenix, and you know you have to refuel, the way we do it right now is, your car has to work one hundred percent of the time, and you have to have all the fuel you need for that journey to make it to Phoenix. There is no such thing as refueling along the way. So now, extend that to a cross country trip, a different orbit if we're using the same analogy: that is a major design decision in how you build a car.

It's the same equation in space. A lot of satellites right now are constructed to survive just the intensity of the launch itself, not the space environment. So, what could different platforms look like if we were able to build them in space, service them in space? And flip that model to one that looks more like what we're experiencing on Earth than this unique space scenario.

Raquel Buscaino: Kim, you mentioned earlier that there is a whole suite of different technologies that are coalescing as we think about the future of the on-demand space economy. So in your perspective, what are the advancements in technology we'll need to realize that vision both within the next ten years, but also beyond?

Kim Crider: You know, I think the tech advances that are going to be most critical speak to some of the items that you and Brett were just talking about. If we're really going to leverage the LEO environment in ways that we're unable to do yet today with having more humans in space, more activities in space, we're going to need that infrastructure, and we're going to need the technologies that will enable that infrastructure to be in place and to be sustained in space.
We just talked about on-orbit servicing capabilities. In order to sustain satellites in space, clearly, those on-orbit servicing vehicles are going to be satellites themselves that will need to be sustained.

We see the advance of certain kinds of technologies that are going to be a part of this: propulsion in particular, as Brett mentioned, fuel is an issue. When satellites move in space, the amount of fuel that they have is referred to as Delta V. "How much Delta V did you bring with you to be able to support all of your manoeuvres in space"? Well, how that Delta V is accomplished is through propulsion, and we need to be able to advance propulsion technology so that those satellites can efficiently manoeuvre and be sustained for a longer lifespan.

Another important advancement certainly is going to be in the area of artificial intelligence. This includes the kinds of AI and Machine Learning technologies that allow for the analysis of data, to understand the environment, to support on orbit sensing, to be able to see what's in the environment more clearly, while you're in space, to be able to identify potential collisions, and to be able to avoid them, and to be able to help those satellite systems self-manoeuvre, self-heal, be self-aware, call for support, communicate with other satellites. Those are going to be important technologies as well.

Cyber security is another really critical capability area today. Certainly, space, as a congested and contested environment, is vulnerable to cyber-attacks. Our capabilities in space very much rely on cyberspace to communicate to the ground, to communicate with each other, so securing those with advanced cyber security capabilities is going to be absolutely critical. The advancements in cyber security are certainly leaning in towards the advanced uses of quantum encryption, as well as quantum computing, and the ability to process large amounts of information at very high speeds is going to be important, and to be able to do that in environments that are remote like space, is going to be certainly part of the future.

Some are very available today, some are still leading-edge technologies like quantum, but it's these kinds of capabilities that are going to, I think, enable us to realize the vision that we have for the future of space.

Raquel Buscaino: Kim, Thank you for walking us through those. It really helps, you understand that there is a huge ecosystem that's really all coming together, and I like the emphasis on AI and Ml because I think a little bit about autonomous vehicles and how you need vehicles that can make very quick decisions within a very specific timeframe. Thousands of miles away, and then, even further as we move past, you know Earth's orbit to the moon, and even beyond, well, you need that on-device decision making more than anything else, and so I think it really speaks to the need of that.

Kim Crider: Well, that's right. And, as we said earlier, we know with more and more satellites going into space, there's going to be an increased need for traffic management capabilities, and so it's that “AI/ML” and autonomy that's really going to help support that.

Raquel Buscaino: So we we've talked about Earth, we talked a lot about space, and I think most people think about them as almost entirely different worlds but this really isn't the case. Even if we produce things on earth to grow the space economy, that economy and its benefits are located here on Earth. It's a symbiotic relationship.

Can you speak to how space technology is helping life on earth, and potentially even the nuanced ways in which companies on earth can participate in space? Because I think that this is going to be a growing question as the space economy evolves: “How do companies participate, and how do they benefit from it?”

Brett Loubert: So I'll start by marvelling how much space is part of our life, and for every person listening to this podcast, your life on earth would look a lot different without space. So when you hop in your car to navigate to work, you rely on space, when you buy a cup of coffee at the coffee shop, you rely on space, when you use your phone, you rely on space. All of these services, and many, many, many more made possible by the GPS constellation, right? And that provides positioning, navigation, and timing that's critical to our everyday life. It's so seamless of what we have and everything we do, you don't even realize how much it’s transparent and part of your life.

One of the most rapidly growing use cases for space is earth observation. Earth observation is a critical capability for national security, but it also provides us important information on things like weather patterns and forest fires, and, most importantly, climate change.

But, let me go back to the bigger picture of “Earth and Space”. We see tremendous opportunities for what I call “Earth companies” to find a role in space. One of the biggest conversations we're having with our clients right now is helping them to see how their products and services on earth could be used in this growing space economy. So, for instance, if you're a company on earth who has developed, let's say, a robot that can travel to extreme sea depths and picks a leaky oil pipeline, you might think “Now you have a role in space that is largely a Zero-G-type, environment”. It's either autonomous or remotely controlled. That environment is a lot like space. It is a harsh environment for humans, and one that maybe actually be a growth area. That that's one of many, many, many that we're looking at. And I think the opportunities are just truly endless.

If you're thinking about it, how do you take that technology and turn it out to work towards space?

Kim Crider: I'll jump in on some of what Brett is saying here in terms of Earth observation. What's been driving a lot of that demand, and interest, and recognition of the value that can be derived from Earth observation capabilities from space, is the availability of a more exquisite, and fine-grained imagery, that's now more available to everyday users. So you can imagine, how many different ways imagery can assist companies in their business models. If you're a logistics company, and you want to keep track of all of your trucks and where they are, or all of your tanker ships, and where they are, well, you know, we can track those, we can understand where things are happening around the world.

Brett mentioned watching weather patterns, and being able to improve weather forecasting, or forecasting natural hazard clean-up and response. The ability to look at traffic patterns on the earth, and plan for city planning in ways to ease up traffic patterns, to provide better services to local citizens. I mean, there's many, many ways in which we see organizations wanting to leverage space.

One of the things Deloitte's been doing is this concept that we call "gravity challenge", which comes up with different problems like traffic pattern management, or climate issues, and invites companies to come in and compete with their ideas on how you could use space-based satellites imagery and what are creative ways to use that data to address the challenges that are being posed.

And we see more and more companies, eager, and interested to take part in that.

Raquel Buscaino: I love the way that you outlined it, because there really are so many different opportunities to participate in space. Deloitte has a space practice where we serve both commercial and government clients? Brett, can you speak to what the near-term and long-term opportunities are for our clients?

Brett Loubert: Well, we're seeing tremendous demand for our services in helping clients figure out their place in this but then also traditional things that we do for clients that are already in this business and they're trying to figure out how they maximize what they're going to do in this industry.

So how do we break this down? We've sort of come up with this framework around space where we talk about "space as a mission". These are clients like Space Force, or NASA, where their primary focus is delivering, or gathering data or capabilities that are derived from space. That is a mission that is existed for as long as space as existed, and one that I've served in my career for over twenty years, and I think is very important. It will continue to be important and continue to be a major driver of supply and demand around space, one that will provide funding for start-ups and companies that are interested in getting into space.

We then talk about a category of "space as a business". There are companies whose whole mission is around space. How do they do launch? How do they do things around satellite construction, development, and manufacturing? These are an area where we can help operate their business more effectively, modernize IT systems. The whole host of services that we can provide.

One that really excites me is "space as a growth opportunity": companies that either have an emerging play in space or could benefit from space data. We see these in markets such as pharmaceutical research and development, health care, and life sciences-type companies, any of those industries that could benefit from all this wealth of data in space. So we see that space as a mission, space as a business, and space as a growth opportunity.

Raquel Buscaino: That's great, wow! Kim and Brett, you've collectively been working in the space industry for many years. What is different today than say a decade ago? What makes this point in time different? Why is now so special.

Kim Crider: Well, I'll start. I think one of the things that makes a difference now is the amount of collaboration that we see going on between governments around the world. We see countries around the world wanting to participate in space, providing launch services and collaborating actively with each other on sharing payloads on launch vehicles, or making their launch services available to others, so that's really exciting.

We also see a lot of collaboration across industry. Industry partners coming together and finding new and innovative ways to bring new solutions around space, in space, from space, as mentioned earlier.

We see collaboration between industry and government, we see collaboration around sharing information about vulnerabilities in space, whether it be vulnerabilities from debris and traffic, and what to do about it, vulnerabilities and

threats with respect to space weather, because there are weather conditions in space, and how does that affect the satellites that are up there? And then, of course, the cyber security threats and in fact, Deloitte is a founding member of the space ISAC, the Space Information Sharing and Analysis Center, focused on space, and sharing information in a public-private partnership way, collaborating on the threats to space from all source threats but predominantly cyber security threats is a big concern.

Brett Loubert: I also I'll go back to a much younger version of me that had more hair. So when I was in college in the late nineties, I wanted to be an aerospace engineer, and I wanted to get into space, and countless people back then told me it was a huge mistake. There was no jobs, and the barrier to entry for being in aerospace, engineering or in space at that point was being a PHD, it was being a rocket scientist.

Interest in space to me is the most exciting advancement that we're seeing today. When you think about space, it's become increasingly accessible in every way. It pulls from every discipline and to me space belongs to everybody. It's all of our place to grow as humanity. It is a growing industry, and we will dominate the next fifty to one hundred years our lives. I can't imagine there's really a better overlap these days, between market opportunity and a subject matter that really captures the human imagination.
Space is a fascinating place is when we think about every single person looks at the moon and says that's interesting. There's not a single person that looks up and says, not interested. This is the kind of place that is exciting for humans.

Raquel Buscaino: Oh, Well, Brett & Kim, and thank you so much for an incredible discussion. In our conversation I felt that we "Kept your eyes to the sky and your feet firmly on the ground" mixing both information with inspiration, so truly, thank you both for the time today.

To all our listeners out there, thanks for tuning in, I'm your host, Raquel Buscaino, and I'll catch you on our next episode. Until then, Stay Savvy.

Sources:

1. Large constellations of Satellites: Mitigating Environmental and Other Effects, GAO-22-105166. Publicly released Sept 29, 2022.
2. The Commercialization of Low Earth Orbit, Volume 1: The time is now. Deloitte Development LLC. Spring 2022.